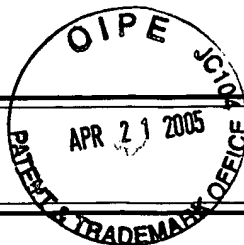


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RADIO BASE STATION APPARATUS AND RADIO TRANSMISSION METHOD

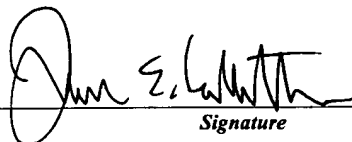
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an English translation of the present Japanese priority application JP 11-287896

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I, the undersigned, Takashi KISO, residing at 5th Floor,
Shintoshicenter Bldg., 24-1, Tsurumaki 1-chome, Tama-shi, Tokyo 206-0034
Japan, hereby certify that to the best of my knowledge and belief the
following is a true translation into English made by me of Japanese Patent
Application No. HEI11-287896 filed on October 8, 1999.

Dated this 6th day of April, 2005

Takashi Kiso
Takashi KISO



Patent Application Number HEI 11-287896

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[Inventor]	
[Address or Residence]	4-3-1, Tsunashimahigashi, Kohoku-ku, Yokohama-shi, Kanagawa Matsushita Communication Industrial Co., Ltd.
[Name]	Kazuyuki MIYA
[Applicant for Patent]	
[Identification Number]	000005821
[Name]	MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
[Agent]	
[Identification Number]	100105050
[Patent Attorney]	
[Name]	Kimihito WASHIDA
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[NAME OF DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION] BASE STATION APPARATUS AND RADIO
TRANSMISSION METHOD

[WHAT IS CLAIMED IS:]

5 [Claim 1] A base station apparatus comprising: two diversity antennas, each
comprised of a plurality of antenna elements, spaced apart from each other by a
distance enabling space diversity; and transmitters provided for each of said two
diversity antennas, each of said transmitters having calculating means for
calculating a transmission weight from a reception weight or direction-of-arrival
10 information obtained by using an uplink signal, and multiplying means for
multiplying a transmission signal spread with a predetermined spreading code
by the transmission weight.

[Claim 2] The base station apparatus according to claim 1, wherein each of
said transmitters further have offset providing means for providing a
15 transmission signal with a phase offset, or a phase offset and a power offset.

[Claim 3] The base station apparatus according to claim 2, wherein the
multiplying means operates as the offset providing means.

[Claim 4] The base station apparatus according to claim 1, wherein each of
said transmitters further have calculating means for performing transmit
20 diversity calculation on a transmission signal to be subjected to spreading.

[Claim 5] A communication terminal apparatus which performs wireless
communication with a base station apparatus according to any of claims 1
through 4.

[Claim 6] A radio transmission method comprising the steps of: calculating a
25 transmission weight from a reception weight or an angle of a direction of arrival
obtained by using an uplink signal; providing a transmission signal spread with
a predetermined spreading code with a phase offset, or a phase offset and a
power offset; multiplying the transmission signal provided with the offset by the

transmission weight; and transmitting the transmission signal multiplied by the transmission weight from two diversity antennas, each comprised of a plurality of antenna elements, spaced apart from each other by a distance enabling space diversity.

5 [Claim 7] A radio transmission method comprising the steps of: calculating a transmission weight from a reception weight or an angle of a direction of arrival obtained by using an uplink signal; performing transmit diversity calculation on a transmission signal; spreading the transmission signal subjected to the transmit diversity calculation with a predetermined spreading code; multiplying the
10 spread transmission signal by the transmission weight; and transmitting the transmission signal multiplied by the transmission weight from two diversity antennas, each comprised of a plurality of antenna elements, spaced apart from each other by a distance enabling space diversity.

[DETAILED DESCRIPTION OF THE INVENTION]

15 【 0 0 0 1 】

[TECHNICAL FIELD OF THE INVENTION]

The present invention relates to a base station apparatus and radio transmission method in a digital radio communication system, and more particularly to a base station apparatus and radio transmission method in a DS-
20 CDMA (Direct Sequence-Code Division Multiple Access) system.

【 0 0 0 2 】

[PRIOR ART]

In a mobile communication, the quality of a received signal deteriorates extremely due to fading. One of effective methods for overcoming the fading is a
25 diversity technique. The diversity technique usually uses a plurality of received signals to achieve transmission of high communication quality. For example, when a receiver has two antennas spaced adequately apart from each other, the fading variation on the antenna is independent of each other. Accordingly,

provability decreases that the power of signals received by the two antennas decreases at the same time. The diversity technique uses such a principle to prevent the power of a received signal from falling down on a receiver side.

【 0 0 0 3 】

5 There are, however, various restrictions to achieve the diversity in a communication terminal apparatus such as a mobile station. Therefore, in order to achieve the diversity, which should be achieved originally on a receiver side in the mobile station, on a transmitter side of a base station, a transmit diversity technique has been investigated.

10 【 0 0 0 4 】

In the transmit diversity, as illustrated in FIG 4, base station 401 transmits signals with the same phase to mobile station 403 using antennas 402a and 402b, and mobile station 403 selects a received signal transmitted from one of the antennas with a power level larger than that of the other signal. Due to the
15 transmit diversity, it is possible to suppress the effect of fading, and to improve the communication quality.

【 0 0 0 5 】

[PROBLEMS TO BE SOLVED BY THE INVENTION]

In the transmit diversity, it is thus possible to suppress the effect of fading,
20 and to improve the communication quality, however, it is not possible to provide interfering suppressing effect that is an effect for suppressing the interference in other stations. Particularly in a CDMA system, suppressing interference in other stations enables each station to perform efficient communications, further enables the system capacity to be increased. Therefore, the interfering
25 suppressing effect becomes important.

【 0 0 0 6 】

The present invention has been made in view of the foregoing with its object to provide a base station apparatus and radio transmission method capable of

suppressing the effect of fading to improve the communication quality, providing the interfering suppressing effect to other stations, and reducing transmission power per mobile station.

【 0 0 0 7 】

5 [MEANS FOR SOLVING THE PROBLEMS]

A base station apparatus of the present invention comprises two diversity antennas, each comprised of a plurality of antenna elements, spaced apart from each other by a distance enabling space diversity, and transmitters provided for each of the two diversity antennas, where each of the transmitters have a
10 calculating section that calculates a transmission weight from a reception weight or an angle of a direction of arrival obtained by using an uplink signal, and a multiplying section that multiplies a transmission signal spread with a predetermined spreading code by the transmission weight.

【 0 0 0 8 】

15 According to this configuration, on communication channels and control channels for specific users, it is possible to suppress fading by the space diversity effect, and to exhibit the interfering suppressing effect due to the narrowed spatial directivity. Accordingly, the apparatus is capable of improving communication qualities by suppressing the fading, of performing efficient
20 communications with each communication terminal apparatus, and thereby of decreasing effects on other terminal apparatuses to increase the system capacity. Further, since the communication qualities are improved, it is not necessary to increase a control amount in the transmit power control, nor to shorten a control cycle. Furthermore, the present invention is effective in shadowing due to the
25 space diversity effect. Since the spatial directivity is narrowed, the apparatus of the present invention is capable of communicating efficiently and of decreasing the transmit power.

【 0 0 0 9 】

In the base station apparatus of the present invention with the above configuration, each of the transmitters further have an offset providing section that provides a transmission signal with a phase offset, or a phase offset and a power offset.

5 【 0 0 1 0 】

According to this configuration, also in the closed-loop mode, on communication channels and control channels for specific users, it is possible to suppress fading by the space diversity effect, and to exhibit the interfering suppressing effect due to the narrowed spatial directivity.

10 【 0 0 1 1 】

In the base station apparatus of the present invention with the above configuration, the multiplying section operates as the offset providing section.

 【 0 0 1 2 】

15 According to this configuration, even when the closed-loop mode is applied as transmit diversity, it is possible to cope with the closed-loop mode without modifying the hardware scale (without increasing the number of multipliers).

 【 0 0 1 3 】

20 In the base station apparatus of the present invention with the above configuration, each of the transmitters further have a calculating section that performs transmit diversity calculation on a transmission signal to be subjected to spreading.

 【 0 0 1 4 】

25 According to this configuration, by the transmit diversity in the open-loop mode, on communication channels and control channels for specific users, it is possible to suppress fading by the space diversity effect, and to exhibit the interfering suppressing effect due to the narrowed spatial directivity.

 【 0 0 1 5 】

A communication terminal apparatus of the present invention has a feature of

performing a radio communication with the above-mentioned base station apparatus. It is thereby possible on communication channels to suppress fading by the space diversity effect, to exhibit the interfering suppressing effect due to the narrowed spatial directivity, and to perform more efficient radio communications.

【 0 0 1 6 】

A radio transmission method of the present invention comprises the steps of calculating a transmission weight from a reception weight or an angle of a direction of arrival obtained by using an uplink signal, providing a transmission signal spread with a predetermined spreading code with a phase offset, or a phase offset and a power offset, multiplying the transmission signal provided with the phase offset by the transmission weight, and transmitting the transmission signal multiplied by the transmission weight from two diversity antennas, each comprised of a plurality of antenna elements, spaced apart from each other by a distance enabling space diversity.

【 0 0 1 7 】

According to this method, in the closed-loop mode, on communication channels and control channels for specific users, it is possible to suppress fading by the space diversity effect, and to exhibit the interfering suppressing effect due to the narrowed spatial directivity.

【 0 0 1 8 】

A radio transmission method of the present invention comprises the steps of calculating a transmission weight from a reception weight or an angle of a direction of arrival obtained by using an uplink signal, performing transmit diversity calculation on a transmission signal, spreading the transmission signal subjected to the transmit diversity calculation with a predetermined spreading code, multiplying the spread transmission signal by the transmission weight, and transmitting the transmission signal multiplied by the transmission weight from

two diversity antennas, each comprised of a plurality of antenna elements, spaced apart from each other by a distance enabling space diversity.

【 0 0 1 9 】

According to this method, in the open-loop mode, on communication
5 channels and control channels for specific users, it is possible to suppress fading by the space diversity effect, and to exhibit the interfering suppressing effect due to the narrowed spatial directivity.

【 0 0 2 0 】

[DESCRIPTION OF THE SPECIAL EMBODIMENTS]

10 The inventors of the present invention paid attention to a transmission adaptive array antenna (smart antenna) technique for providing the interfering suppressing effect, and achieved a base station apparatus and radio transmission method for providing both the fading suppressing effect and interfering
15 adaptive array antenna technique only on a communication channel (including packets) and a control channel for a specific user (FACH (Forward Access Channel) and AICH (Acquisition Indication CHannel)) to which the transmission adaptive array antenna technique is applicable.

【 0 0 2 1 】

20 It is a gist of the present invention that, as illustrated in FIG 1, base station apparatus 10 performs the transmit diversity using diversity antennas 11a and 11b, while further performing the transmission adaptive array antenna control, for communication terminal apparatus 20.

【 0 0 2 2 】

25 Hereinafter, there will be described the embodiments of the present invention in detail in accordance with the accompanying drawings.

(Embodiment 1)

As transmit diversity schemes, there are two schemes, namely, closed-loop

mode transmit diversity and open-loop mode diversity. This embodiment describes a case of the closed-loop mode type of transmit diversity. The present invention is capable of being applied to both an FDD (Frequency Division Duplex) system and TDD (Time Division Duplex) system. The case of the FDD system will be described here. A case will be described that a radio transmission method of the present invention is applied only to a communication channel (including packets) and a control channel for a specific user (FACH and AICH).

【 0 0 2 3 】

FIG 2 is a block diagram showing a configuration of a base station apparatus according to Embodiment 1 of the present invention. The base station apparatus has two diversity antennas 101 spaced apart from each other by a distance enabling space diversity, and two processing sequences each having receiver 103 and transmitter 104 provided for a corresponding diversity antenna 101. The switching between transmission and reception for the transmitter and receiver is performed by duplexers 102a to 102c. In addition, in the case of the TDD system, the switching between transmission and reception for the transmitter and receiver is performed by switches, instead of the duplexers.

【 0 0 2 4 】

In an actual communication, since a plurality of channels are multiplexed, a dividing section that divides a received signal for each channel is provided on an output side of a reception RF circuit on a receiver side, while a multiplexing section that multiplexes a plurality of channel transmission signals is provided on an input side of a transmission RF circuit. However, to simplify the explanation, FIG 2 illustrates the configuration for one channel with the dividing section and multiplexing section omitted.

【 0 0 2 5 】

Signals transmitted from a communication terminal apparatus are received at diversity antenna 101 comprised of a plurality of (three in FIG 3) antenna

elements 101a to 101c, and output to reception RF circuits 1031a to 1031c through duplexers (Dup) 102a to 102c, respectively. Reception RF circuits 1031a to 1031c perform predetermined radio reception processing (downconverting, A/D conversion, etc) to respective received signals. In the actual communication, the received signal subjected to the radio reception processing is divided into channel signals.

【 0 0 2 6 】

The received signals subjected to the radio reception processing are respectively output to matched filters (MF) 1032a to 1032c, and are despread using respective spreading codes used in spreading the transmission data on the communication terminal apparatus side. Thus despread signals are output to a reception adaptive array antenna (AAA) (direction-of-arrival estimating circuit) 1033.

【 0 0 2 7 】

Reception AAA circuit 1033 (or direction-of-arrival estimating circuit) 1033 performs reception AAA processing or direction-of-arrival estimating processing. These kinds of processing will be described later. Thus processed signal is output to combining circuit 105 for each diversity antenna, combined in combining circuit 105, and obtained as a received signal. Weight information and angle information on the direction of arrival obtained in the reception AAA processing or direction-of-arrival estimating processing is output to transmission weight calculating circuit 1042 in transmitter 104.

【 0 0 2 8 】

Meanwhile, a transmission signal is output to modulating circuit 106 and subjected to digital modulation processing therein. The modulated signal is output to spreading circuit 107 and spread with a predetermined spreading code. At this point, two processing sequences use the same spreading code. The spread signal (transmission signal) is output to transmission weight multiplying section

1043 through transmit diversity circuit 1041 of each transmitter 1045. Transmit diversity circuit 1041 performs transmit diversity processing according to transmit diversity control signals 1 and 2.

【 0 0 2 9 】

5 Transmission weight multiplying section 1043 multiplies the transmission signal by a respective transmission weight calculated in transmission weight calculating circuit 1042, in each of multipliers 1043a to 1043c provided for corresponding antennas. The transmission signals each multiplied by the transmission weight are output to respective transmission RF circuits 1044a to
10 1044c, and therein, subjected to predetermined radio transmission processing (D/A conversion, upconverting, etc). At this point, transmission RF circuits 1044a to 1044c have an input control signal for closed-loop and/or open-loop transmit power control, and according to the transmit power control signal, control the transmit power. In the actual communication, the transmission signal
15 multiplied by the transmission weight undergoes the transmit power control, and then transmission signals of a plurality of channels are multiplexed. The multiplexed signal undergoes the radio transmission processing. The transmission signals subjected to the radio transmission processing are output to duplexers 102a to 102c, and then transmitted from antenna elements 101a to 101c
20 to a communication terminal apparatus, respectively.

【 0 0 3 0 】

The operation of the base station apparatus with the above configuration will be described below.

25 Signals received from diversity antenna 101 are subjected to radio reception processing in reception RF circuits 1031a to 1031b for respective antenna elements 101a to 101c, then despread in matched filters 1032a to 1032c, respectively, and output to reception AAA circuit (or direction-of-arrival estimating circuit) 1033.

【 0 0 3 1 】

Reception AAA circuit (or direction-of-arrival estimating circuit) 1033 obtains weights and directions of arrival for forming an optimal reception radiation pattern, using uplink signals received in respective antenna elements. The weight information and direction-of-arrival information (angle of arrival) is output to transmission weight calculating circuit 1042, which calculates transmission weights. There are various methods as described below for obtaining a weight of reception directivity and direction-of-arrival information from a received signal to calculate a transmission weight.

【 0 0 3 2 】

A first one is such a method that obtains a reception weight in reception AAA processing in reception AAA circuit (or direction-of-arrival estimating circuit) 1033, and using the weight, calculates a transmission weight. For example, there is a method for obtaining the reception weight using beam steering. In addition, the reception AAA processing is described in IEICE TRANS.COMMUN., VOL.E77-B.NO.5 MAY 1994 "Spectral Efficiency Improvement by Base Station Antenna Pattern Control for Land Mobile Cellular systems." Entire content of which is expressly incorporated by reference herein.

【 0 0 3 3 】

In this method, as illustrated in FIG 2, in the FDD system, since different frequencies are used between transmission and reception, when the weight obtained in the reception AAA processing is used to calculate a transmission weight, a different radio pattern is obtained at the time of transmission. Therefore, transmission weight calculating circuit 1042 performs regeneration of weights using reception weights obtained in the reception AAA processing. The weight regeneration method is described in also in IEICE TRANS.COMMUN., VOL.E77-B.NO.5 MAY 1994 "Spectral Efficiency Improvement by Base Station Antenna Pattern Control for Land Mobile Cellular systems", entire content of

which is expressly incorporated by reference herein.

【 0 0 3 4 】

In this method, in the TDD system, since the same frequency is used in transmission and reception, transmission weight calculating circuit 1042
5 calculates transmission weights using the weights themselves obtained in the reception AAA processing.

【 0 0 3 5 】

A second one is such a method that obtains a reception weight in the reception AAA processing in reception AAA circuit (or direction-of-arrival
10 estimating circuit) 1033, estimates a direction of arrival of an uplink signal from the reception weight, and calculates a transmission weight using the estimated value. In the reception AAA processing, a null direction is set by null steering, and therefore the direction of arrival is not obtained necessarily. Accordingly, using the reception weight obtained in the reception AAA processing, a beam
15 direction with the maximum power of a desired signal is detected, and the direction of arrival is estimated from candidate directions of arrival.

【 0 0 3 6 】

After the direction of arrival is thus estimated, the estimated value (angle information) is output to transmission weight calculating circuit 1042, and
20 according to the estimated value, the circuit 1042 calculates a transmission weight for pointing a beam. Samples of the method for calculating a transmission weight from the obtained estimated value is a method for preparing in advance a table relating an estimated value to a transmission weight and referring to the table after obtaining the estimated value to obtain a transmission weight, and
25 another method for performing beam forming using the obtained estimated value and adaptively obtaining a transmission weight.

【 0 0 3 7 】

A third one is such a method that estimates a direction of arrival of an uplink

signal without using a reception weight, and calculates a transmission weight using the estimated value. The method for estimating a direction of arrival of an uplink signal is not limited to a particular one. For example, either method would be used that is described in "Design • Analysis Method Workshop in
5 Antenna • Propagation (No.10)-Adaptive Signal Processing Technique by Array Antenna and High-Resolution Direction of Arrival Estimation Introduction Course-Oct.30,1997".

【 0 0 3 8 】

After the direction of arrival is thus estimated, the estimated value (angle
10 information) is output to transmission weight calculating circuit 1042, and according to the estimated value, the circuit 1042 calculates a transmission weight for pointing a beam. Samples of the method for calculating a transmission weight from the obtained estimated value are, as in the second method, a method for preparing in advance a table relating an estimated value to a
15 transmission weight and referring to the table after obtaining the estimated value to obtain a transmission weight, and another method for performing beam forming using the obtained estimated value and adaptively obtaining a transmission weight.

【 0 0 3 9 】

20 Meanwhile, a transmission signal is subjected to digital modulation processing in modulating circuit 106, is spread with a predetermined spreading code (the same code for two diversity antennas) in spreading circuit 107 in spreading circuit 107, and is output through transmit diversity circuit 1041 to multipliers 1043a to 1043c in transmission weight multiplying section 1043.

25 【 0 0 4 0 】

Transmit diversity circuit 1041 performs transmit diversity using transmit diversity control signals 1 and 2. Specifically, transmit diversity circuit 1041 multiplies the spread transmission signal by a weight indicated by each of

transmit diversity control signals 1 and 2.

【 0 0 4 1 】

The weight indicated by each of transmit diversity control signals 1 and 2 is of a phase offset, or phase and power offsets in the closed-loop mode. As the
5 closed loop mode, there are two modes, i.e., a mode for using a phase offset as the transmit diversity control signal, and another mode for using a phase offset and power offset as the transmit diversity control signal. This embodiment is capable of being applied to both closed-loop modes, in other words, to both case of using a phase offset as the transmit diversity control signal, and of using a
10 phase offset and power offset as the transmit diversity control signal.

【 0 0 4 2 】

In the closed-loop mode, a base station apparatus provides antennas (in this case, two diversity antennas each comprised of a plurality of antenna elements) with different phase rotations (for example, 90° shift) or different power offsets
15 (for example, 8:2 or 2:8 in power ratio) to perform transmission. The control on the offset is determined by a communication terminal apparatus. In other words, the communication terminal apparatus determines, using signals transmitted from both antennas, an extent of a phase difference between both signals, or extents of a phase difference and power difference therebetween, and transmits
20 the control information to the base station apparatus, and according to the control information, the base station apparatus performs transmission.

【 0 0 4 3 】

The transmission signal with the offset provided in transmit diversity circuit 1041 is multiplied by a transmission weight in each of multipliers 1043a to 1043c
25 in transmission weight multiplying section 1043. The transmission weight is calculated in transmission weight calculating circuit 1042, as described above, based on the weight information and angle information obtained in the reception AAA circuit and the direction-of-arrival estimating circuit. The transmission

signals each thus multiplied by the transmission weight are subjected to predetermined radio transmission processing in respective transmission RF circuits 1044a to 1044c, and then are transmitted in beam forming state to a communication terminal apparatus. In this case, parallel diversity transmission is performed using two diversity antennas 101 spaced apart from each other by a distance enabling space diversity.

【 0 0 4 4 】

In addition, in the case other than a case of the closed-loop mode, a spread transmission signal is multiplied by the above-mentioned transmission weight in each of multipliers 1043a to 1043c in transmission weight multiplying section 1043.

【 0 0 4 5 】

The base station apparatus according to this embodiment is capable, on communication channels and control channels for specific users, of suppressing fading by the space diversity effect and of exhibiting the interfering suppressing effect due to the narrowed spatial directivity. Accordingly, the apparatus is capable of improving communication qualities by suppressing the fading, of performing efficient communications with each communication terminal apparatus, and thereby of decreasing effects on other terminal apparatuses to increase the system capacity. Further, since the communication qualities are improved, it is not necessary to increase a control amount in the transmit power control, nor to shorten a control cycle. Furthermore, the present invention is effective in shadowing due to the space diversity effect. Since the spatial directivity is narrowed, the apparatus of the present invention is capable of communicating efficiently and of decreasing the transmit power.

【 0 0 4 6 】

In the configuration illustrated in FIG 2, a spread transmission signal is multiplied by a phase offset in the closed-loop mode, and is further multiplied by

a transmission weight. The multiplication of the phase offset and of transmission weight may be performed together in a same processing section. In other words, a configuration may be possible in which one multiplying section multiplies a spread transmission signal by a phase offset and by a transmission weight. It is
5 thereby possible to cope with the closed-loop mode without modifying the hardware scale (without increasing the number of multipliers), when the closed-loop mode is applied.

【 0 0 4 7 】

(Embodiment 2)

10 This embodiment describes a case that STTD (Space Time Transmit Diversity) that is an example of the open-loop mode is applied. Also in this case, the present invention is capable of being applied to both the FDD (Frequency Division Duplex) system and TDD (Time Division Duplex) system. A case will be described that a radio transmission method of the present invention is applied
15 only to a communication channel (including packets) and a control channel for a specific user (FACH and AICH).

【 0 0 4 8 】

FIG 3 is a block diagram showing a part of the configuration of a base station apparatus according to Embodiment 2 of the present invention. In FIG 3, parts
20 similar to those in FIG 2 are denoted by the same reference numerals as those in FIG 2, and detailed description will be eliminated.

【 0 0 4 9 】

The base communication apparatus is provided on a transmitter side with modulating circuit 106 that performs digital modulation processing on a
25 transmission signal, transmit diversity circuit 201 that performs transmit diversity processing on the modulate transmission signal, spreading circuit 202 that spreads the transmission signal subjected to the transmit diversity processing, transmission weight multiplying circuit 1043 that multiplies the

spread transmission signal by a transmission weight calculated in transmission weight calculating circuit 1042, and transmission RF circuits 1044a to 1044c that perform predetermined transmission processing on respective transmission signals each multiplied by the transmission weight.

5 【 0 0 5 0 】

The operation of the base station apparatus with the above configuration will be described below.

The apparatus operates in the same way as in the first embodiment until the apparatus acquires reception weight information or direction-of-arrival
10 information using an uplink signal from a communication terminal apparatus, and calculates a transmission weight in transmission weight calculating circuit 1042 from the reception weight or direction-of-arrival information.

 【 0 0 5 1 】

Meanwhile, a transmission signal is output to modulating circuit, and is
15 subjected to digital modulation processing. The digital modulated signal is output to transmit diversity circuit 201. Transmit diversity circuit 201 performs transmit diversity calculation (STTD encode) on the digital modulated transmission signal. In the STTD encode, as signals to be transmitted from another transmission antenna at the same time as every successive two symbols
20 (S1, S2), the calculation is performed to obtain (-S2*, S1*). "*" indicates complex conjugate.

 【 0 0 5 2 】

The transmission signal subjected to the transmit diversity calculation is output to spreading circuit 202. Spreading circuit 202 spreads the transmission
25 signal with a predetermined spreading code (the same spreading code for two diversity antennas).

 【 0 0 5 3 】

The spread transmission signal is multiplied by a transmission weight in each

of multipliers 1043a to 1043c in transmission weight multiplying section 1043. The transmission weight is calculated in transmission weight calculating circuit 1042, as explained in the first embodiment, based on the weight information and angle information obtained in the reception AAA circuit and the direction-of-arrival estimating circuit. The transmission signals each thus multiplied by the transmission weight are subjected to predetermined radio transmission processing in respective transmission RF circuits 1044a to 1044c, and then are transmitted in beam forming state to a communication terminal apparatus. In this case, parallel diversity transmission is performed using two diversity antennas 101 spaced apart from each other by a distance enabling space diversity.

【 0 0 5 4 】

The base station apparatus according to this embodiment is capable, on communication channels and control channels for specific users, of suppressing fading by the space diversity effect and of exhibiting the interfering suppressing effect due to the narrowed spatial directivity. Accordingly, the apparatus is capable of improving communication qualities by suppressing the fading, of performing efficient communications with each communication terminal apparatus, and thereby of decreasing effects on other terminal apparatuses to increase the system capacity. Further, since the communication qualities are improved, it is not necessary to increase a control amount in the transmit power control, nor to shorten a control cycle. Furthermore, the present invention is effective in shadowing due to the space diversity effect. Since the spatial directivity is narrowed, the apparatus of the present invention is capable of communicating efficiently and of decreasing the transmit power.

【 0 0 5 5 】

In addition, in the open-loop mode, since a communication terminal apparatus does not need to transmit a control signal to a base station apparatus, the control can be simplified between the communication terminal apparatus and base

station apparatus.

【 0 0 5 6 】

The present invention is not limited to the above-mentioned embodiments, and is capable of being carried into practice with various modifications thereof.

5 For example, in the above-mentioned first to second embodiments, a case is described that a receiver of the base station apparatus receives signals using an adaptive array antenna, however, the present invention is capable of being applied similarly also to a case that the receiver does not use an adaptive array antenna in receiving signals. Further, in the above-mentioned first to second
10 embodiments, a case is described that transmission and reception on uplink and downlink are performed in the FDD system, however, the present invention is capable of being applied similarity also to a case where transmission and reception on uplink and downlink are performed in the TDD system.

【 0 0 5 7 】

15 [EFFECT OF THE INVENTION]

As described above, according to the present invention, it is possible, on communication channels and control channels for specific users, to suppress fading by the space diversity effect and to exhibit the interfering suppressing effect due to the narrowed spatial directivity.

20 [BRIEF DESCRIPTION OF DRAWINGS]

[FIG 1]

A concept diagram of a radio transmission method according to the present invention;

[FIG 2]

25 A block diagram showing a configuration of a base station apparatus according to Embodiment 1 of the present invention;

[FIG 3]

A block diagram showing a part of the configuration of a base station

apparatus according to Embodiment 2 of the present invention; and

[FIG 4]

A concept diagram for explaining transmit diversity.

[EXPLANATIONS OF LETTERS OR NUMERALS]

5	101	DIVERSITY ANTENNA
	101a~101c	ANTENNA ELEMENTS
	102a~102c	DUPLEXERS
	103	TRANSMITTER
	104	RECEIVER
10	105	COMBINING CIRCUIT
	106	MODULATING CIRCUIT
	107	SPREADING MODULATION CIRCUIT
	1031a~1031c	RECEPTION RF CIRCUIT
	1032a~1032c	MATCHED FILTER
15	1033	RECEPTION ADAPTIVE ARRAY ANTENNA CIRCUIT (DIRECTION-OF-ARRIVAL ESTIMATION CIRCUIT)
	1041	TRANSMIT DIVERSITY CIRCUIT
	1042	TRANSMISSION WEIGHT CALCULATING CIRCUIT
	1043	TRANSMISSION WEIGHT MULTIPLYING SECTION
20	1043a~1043c	MULTIPLIERS
	1044a~1044c	TRANSMISSION RF CIRCUIT

[NAME OF DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT] Suppressing the effect of fading to improve the communication quality, providing the interfering suppressing effect to other stations, and
5 reducing transmission power per mobile station;

[OVERCOMING MEANS] Only on a communication channel (packets) and a control channel for a specific user (FACH or AICH), base station apparatus
10 performs transmit diversity using diversity antennas 11a and 11b, while further performing transmission adaptive array antenna control, for
10 communication terminal apparatus 20.

[SELECTED DRAWING] FIG 1



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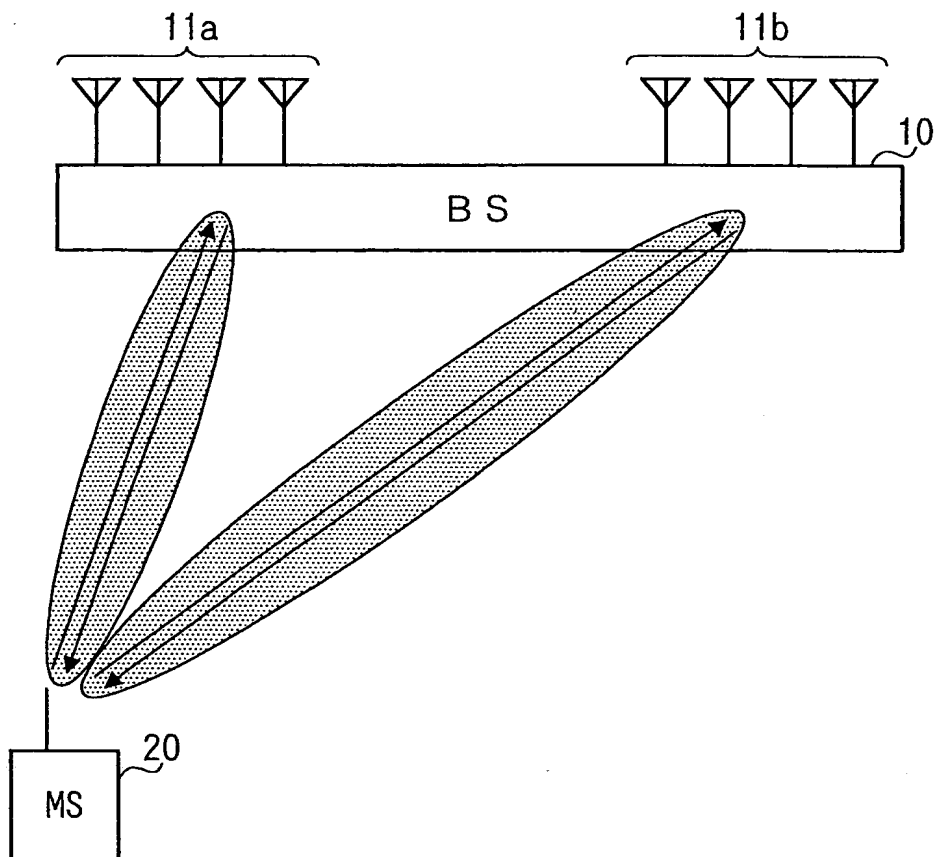


FIG. 1

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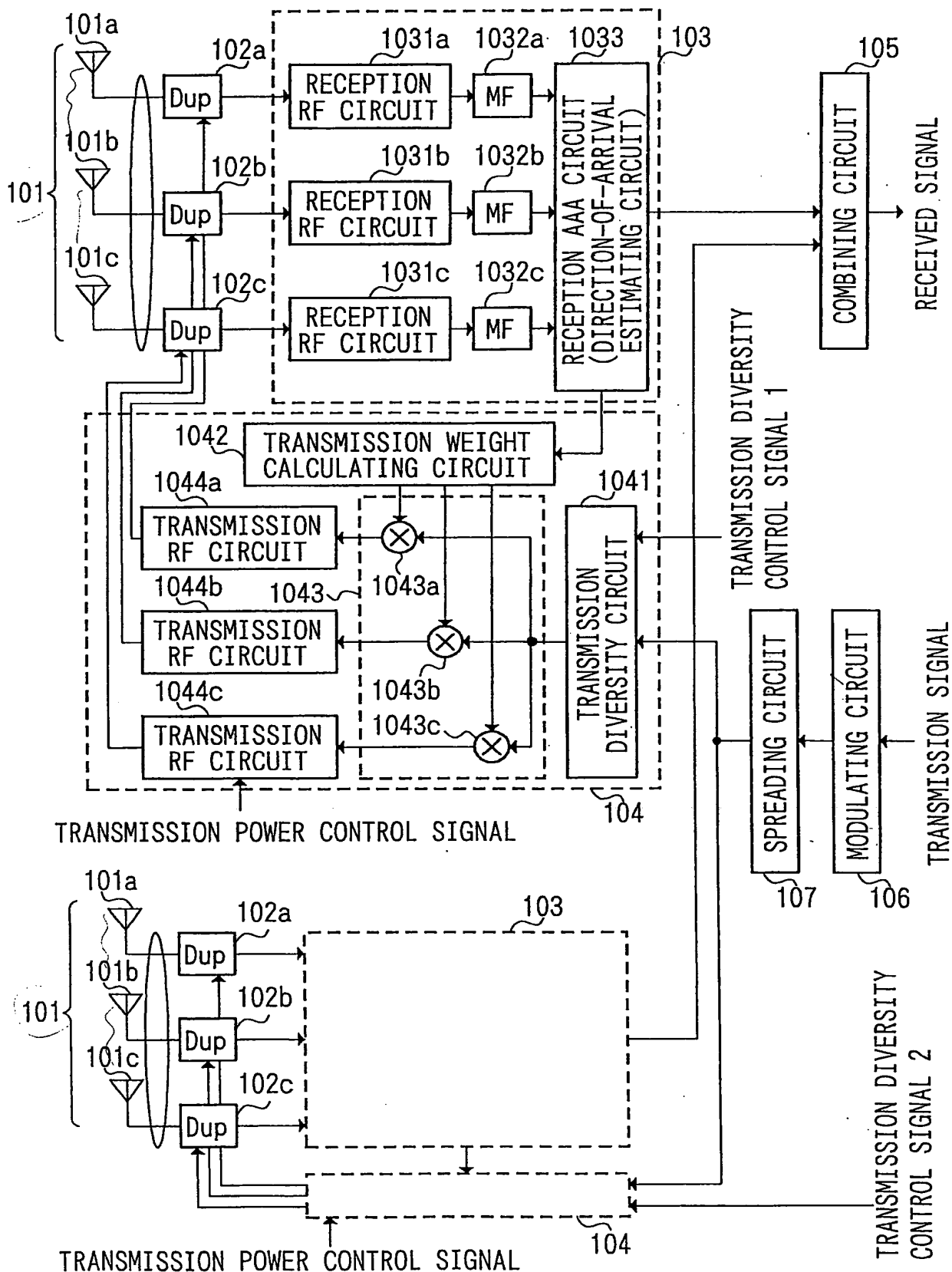


FIG. 2

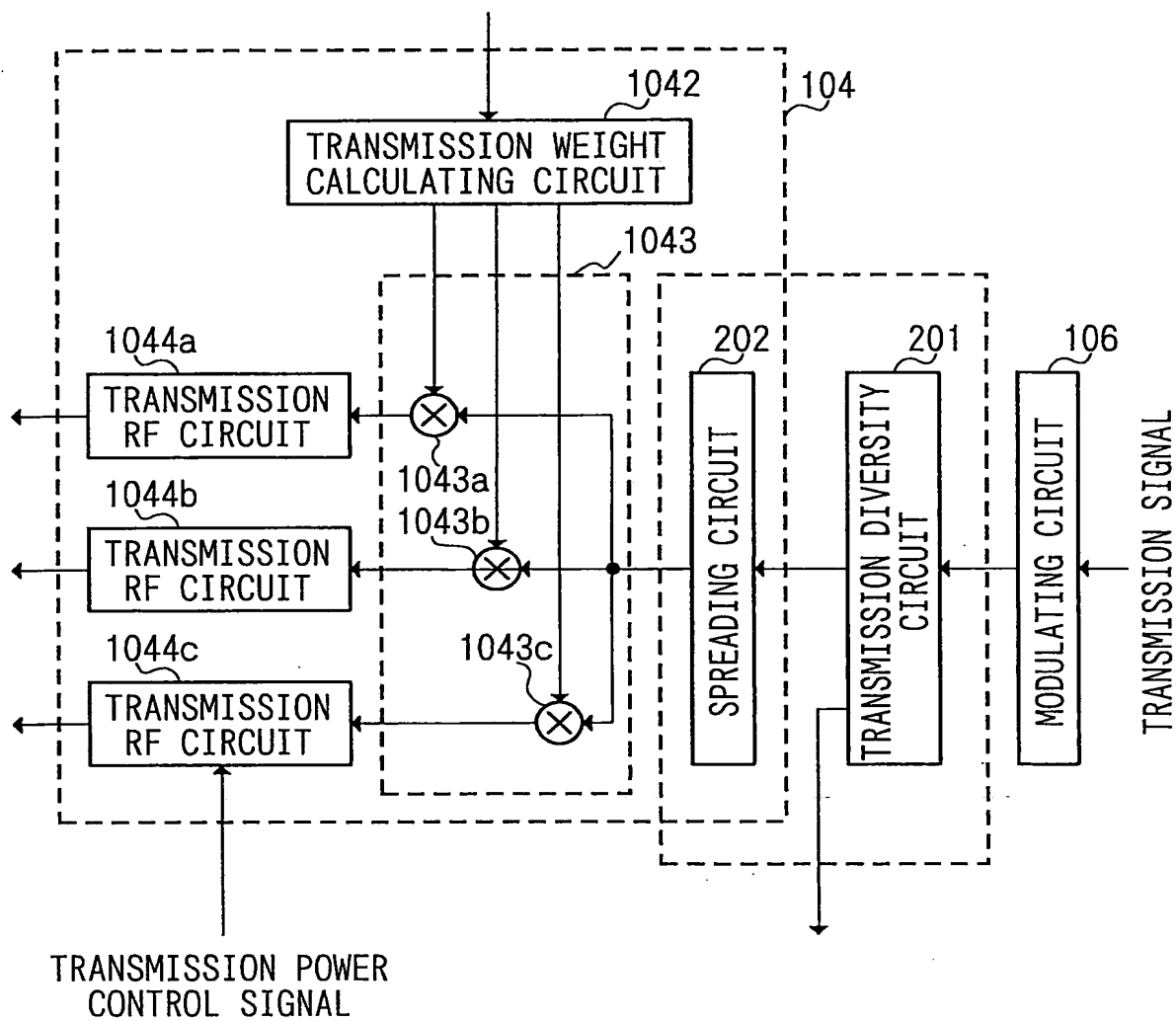


FIG. 3



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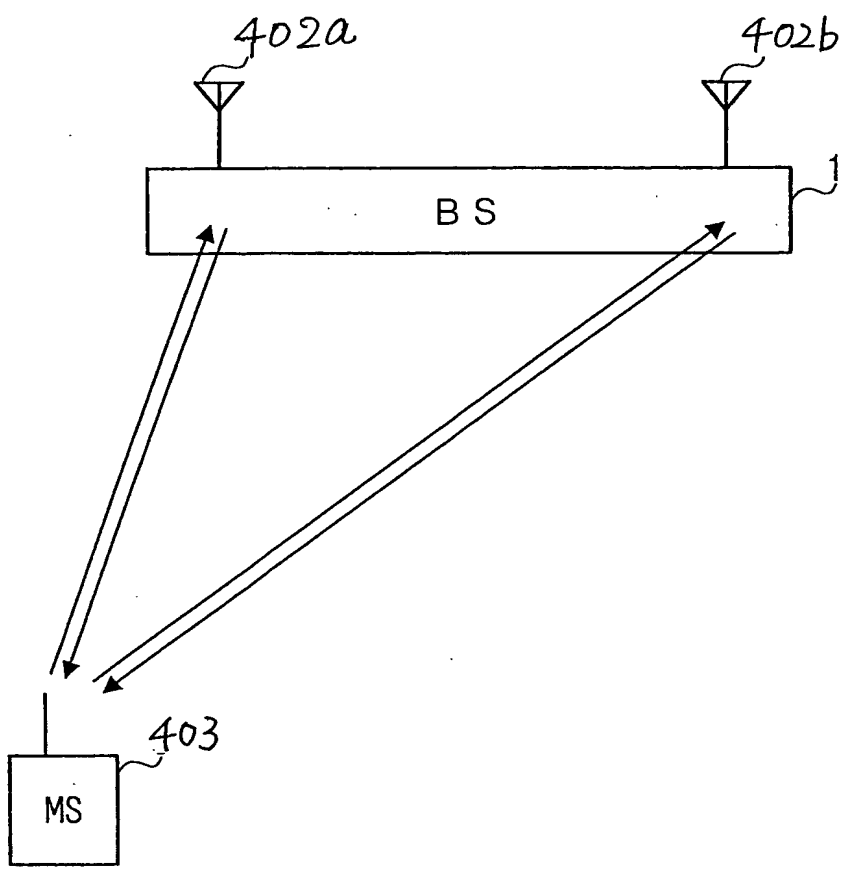


FIG. 4